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1. Your reference

JRJC/LMS/36859

2. Patent application number
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0202389.3

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

VIRGIN ATLANTIC AIRWAYS LIMITED
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United Kingdom

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

7473610005

4. Title of the invention

A PASSENGER SEAT ASSEMBLY FOR A VEHICLE

5. Name of your agent *(if you have one)*

FJ CLEVELAND

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A PASSENGER SEAT ASSEMBLY FOR A VEHICLE

The present invention relates to a passenger seat assembly for a vehicle, particularly an aircraft. The present invention also embraces a vehicle cabin installation comprising a plurality of passenger seat assemblies in accordance with the invention.

A conventional passenger seat for an aircraft comprises a back-rest and a seat-pan that are supported off the floor of the vehicle by means of suitable supporting structure that is anchored to seat tracks in the floor. Usually, the back-rest of the seat is capable of reclining from an upright position to a reclined position for the comfort of a passenger using the seat during the course of a flight. Some prior art passenger seats, particularly seats for use in business-class and first-class of sections of aircraft, where the pitch between adjacent rows of seats is usually greater than in an economy-class cabin, also comprise a leg-rest which is pivoted to the front of the seat-pan and is capable of movement between a lowered or stowed position, in which the leg-rest depends from the seat pan generally vertically towards the floor, and a raised or deployed position in which the leg-rest extends forwardly of the seat-pan to bear the passenger's legs off the floor. Thus, it is possible with conventional aircraft passenger seats to obtain a fair degree of

comfort by reclining the back-rest and elevating the leg-rest, when fitted.

Whilst the above-described arrangement of conventional aircraft passenger-seats is generally satisfactory for short-haul flights having a duration of up to three to four hours, it is not generally satisfactory for use on flights of longer duration when passengers typically wish to go to sleep. Even in the reclined position described above, a passenger using the seat remains in a general sitting position. Many passengers find it difficult to sleep properly, if at all, when sitting. In recent years there has been a significant increase in the number of passengers who regularly make long-haul flights. There has therefore been a trend in the art to devise passenger seats which allow passengers to adopt further reclined positions during the course of a flight to facilitate sleeping. This is particularly important for passengers who travel for business purposes when it is desirable for them to arrive at their destinations feeling refreshed and alert.

One possibility that has been disclosed in the art for increasing the degree to which an aircraft passenger seat can be reclined comprehends simply increasing the extent to which the back-rest can be reclined backwards and the leg-rest elevated. In the extreme, it is possible to form a substantially flat bed by using such a technique in which the back-rest is reclined and the leg-rest raised to such an extent that they are disposed substantially co-planarly with the seat-pan and each other. A disadvantage with such a system is that the pitch between adjacent

rows of seats must be substantially increased to accommodate the full height of a passenger. Whilst this is sometimes possible in the first-class area of an aircraft cabin, it is generally uneconomic even for a business-class cabin, let alone an economy-class layout. Furthermore, whilst it is possible to form a generally flat surface which is disposed substantially horizontally, the surface is still not ideal, because the foam or other padding on the seat is generally sculptured for use as a seat, whereas for a bed, it is desirable to have a substantially flat surface.

GB 2326824 A discloses a seating unit for an aircraft cabin comprising a secondary seat positioned to face a primary seat, the secondary seat having a seating portion positioned to cooperate with a leg-rest of the primary seat to form a continuous flat sleeping surface when the back-rest of the primary seat is reclined to a horizontal position. The seating unit of GB 2326824 A has the advantage that by incorporating an additional secondary seat in the flat sleeping surface together with back-rest, seating portion and leg-rest of the primary seat, it is possible to form a long sleeping surface which is able to accommodate comfortably passengers having a height greater than 6ft (1.83m). However, it will be appreciated that the seating unit of GB 2326824 A represents an even greater overhead in turns of cabin space than the conventional system described above and, moreover, still suffers from the disadvantage that the seat cushioning is designed principally for use as a seat and not a bed. In view of its overall length,

the seating unit of GB 2326824 A is wholly unsuitable for use in a business-class section of an aircraft.

WO 00/21831 A2 discloses a seating unit which can be converted into a bed for use principally in a business-class section of aircraft cabin. The seating unit of WO 00/21831 A2 comprises a pair of seats facing in opposite directions, each seat comprising a seating space for the seated body of an occupant, and an extension space in which the legs of an occupant may be placed. The seats are positioned each side of a notional dividing axis with the seating space of one extending over the axis into the extension space of the other. When installed in an aircraft cabin, one of the seats faces substantially forwards and the other faces substantially aft. Each seat of the seating unit of WO 00/21831 A2 is substantially the same as the seating unit in GB 2326824 A described above, but without a leg-rest. Each seat thus comprises a primary seat having a reclinable back-rest and seat-pan and a secondary seat consisting of a seat-pan for spaced forwardly of the primary seat and also serving as an immovable foot-rest. The primary seat can be reclined such that as the back-rest is reclined, the seat-pan moves forwardly to meet the secondary seat to form a continuous surface therewith which serves as a sleeping surface for a passenger. As with GB 2326824 A, the seating unit of WO 00/21831 A2 has the advantage of providing a substantially horizontal sleeping surface for a passenger during long-haul flights. However, the seating unit of WO

00/21831 A2 is still extravagant in terms of space within a typical business-class cabin, and also suffers from the disadvantage that when configured as a bed, each seat is unable to accommodate comfortably tall passengers. As with the other prior art seats described above, each of the seats of the seating unit of WO 00/21831 A2 also suffers from the disadvantage that the seat cushioning is not specifically designed for use as a bed surface, but is contoured for use principally as a seating surface.

An object of the present invention therefore is to provide an improved passenger seat assembly for a vehicle, particularly an aircraft. In particular, it is an object of the invention to provide an improved passenger seat assembly for use in the business-class section of an aircraft where the pitch between adjacent rows of seats is typically in the range of 50-60 inches (1.27 to 1.52 metres).

Another object of the present invention is to provide a passenger seat assembly which can be converted into a bed having maximal length to accommodate tall passengers, particularly those having height greater than 6ft (1.83 metres).

Yet another object of the present invention is to provide a passenger seat assembly for an aircraft having a seating surface which is particularly adapted for use as a seating surface and a bed surface that is particularly adapted for use as a bed surface.

A different object of the present invention is to provide a passenger seating assembly which can be converted into a bed and which promotes or contributes to a first cabin ambience when configured as a seat and a second, different cabin ambience when configured as a bed. Thus, it is a particular object of the invention to provide a seating installation for an aircraft cabin comprising a plurality of seat assemblies which can be converted into beds and which, when all or a majority of the seats are configured as seats, the cabin has a particular first overall visual appearance and, when all or a majority of the seats are configured as beds, the cabin has a second overall appearance or ambience.

Further objects of the inventions will be apparent to those skilled in the art from the following description of the invention and specific embodiment of the invention.

According to one aspect of the present invention there is provided a passenger seat assembly for a vehicle, particularly an aircraft, comprising:

supporting structure for supporting said assembly off the floor of a vehicle, said supporting structure optionally comprising one or more fixed passenger-bearing surfaces; one or more movable passenger-bearing components: and means for connecting said movable components to said structure such that the components can be selectively moved between a seat configuration in which one or more of said moveable components and fixed bearing surfaces form a seat for a

passenger, and a bed configuration in which one or more of said movable components and bearing surfaces form a bed for the passenger; wherein at least one of said movable components is double-sided, comprising first and second opposite sides, one of said sides having a first seat surface that is adapted to form part of said seat, and the other side having second bed surface that is adapted to form part of said bed.

Thus, in accordance with the present invention, a seat assembly is provided having a plurality of moveable components which together, and optionally with one or more fixed surfaces, form a seat. The seat assembly of the invention can be converted into a bed configuration in which one or more of the movable components, optionally with one or more fixed surfaces, form a sleeping surface for a passenger. The present invention is characterised in that at least one of the moveable components of the assembly has first surface that is specifically adapted for use as a seating surface, and second opposite side that is specifically adapted for use as sleeping surface. Thus, said one side of said double-sided movable component may carry a layer of foam padding having a contoured surface that is shaped for use as a seat component, and said other side may carry a layer of foam padding having a substantially flat surface for use as part of a bed. Said first side of said double-sided movable component may have a first appearance that contributes or promotes an overall cabin appearance that is suitable for a seating

environment. For instance, said first surface may have a leather or simulated leather seat covering. At the same time, said second surface may have a visual appearance which contributes to or promotes an overall cabin ambience that is suitable for a sleeping environment. Thus, said second surface may be upholstered in fabrics or other materials having an appearance that is usually associated with bedding materials.

Preferably, said double-sided component is a back-rest component. Said back-rest component may be connected to the supporting structure such that it can be pivoted between a first generally upright position in which the first surface is arranged to form part of the seat, and a second prone position in which said second surface is arranged to form part of the bed. Preferably, the second bed surface of the back-rest component is substantially horizontal in the second prone position.

In some embodiments, one or more of said fixed surfaces and movable components may define a seat-pan. Said back-rest may be pivoted to the structure such that in the second prone position, the back-rest overlays the seat-pan. Thus, in accordance with the present invention, said seat-pan may have a dedicated seating surface which is shaped and upholstered specifically for use as a seat. In the bed configuration, the seat-pan may be wholly or partially concealed by the back-rest component in the second prone position such that the seating appearance

of the seat-pan is hidden by the back-rest.

In some embodiments, said seat-pan may comprise one of said moveable components which is connected to said supporting structure for movement in a vertical plane between an upper deployed position and a lower stowed position. Thus, in said second prone position, the back-rest component may occupy the space that is normally occupied by the seat-pan in the upper deployed position, the seat-pan being displaced to its lower stowed position in the bed configuration. This feature of the present invention allows the bed surface of the seat assembly to be provided at a relatively low-level off the floor of the vehicle to make it easy for a passenger to climb in to and out of the bed.

In preferred embodiments of the present invention, a leg-rest surface may be provided, which leg-rest surface may be defined by or deployable from said supporting structure. Said leg-rest surface is preferably disposed at a position spaced forwardly of the seat-pan. Said seat assembly may not have a leg-rest component that is connected to and deployable from the seat-pan. Thus, in place of such a conventional leg-rest, the seat assembly of the present invention may include a leg-rest surface at a position spaced forwardly of the seat-pan to serve as a foot-rest.

In some embodiments, said back-rest component may be pivoted to the supporting structure such that as it moves from the upright position to the prone

position it moves translationally forwardly to meet the leg-rest surface such that in the prone position the second bed surface and the leg-rest surface form a continuous surface for sleeping on. In a preferred aspect of the invention, the structure may also comprise a fixed extension surface behind the back-rest component. A movable infill component may be provided that is connected to the structure such that it is moveable between a stowed position when the back-rest component is upright and a deployed position when the back-rest is prone; wherein said infill component comprises a passenger-bearing infill surface that extends substantially horizontally between the back-rest component and fixed extension surface when deployed, such that said extension surface, infill surface and second surface form a continuous surface. Said infill component may be mounted pivotably behind the back-rest component intermediate the extension surface, such that in the stowed position the infill component may be angled to the horizontal and, upon deployment, may be pivoted to the deployed position.

Thus in bed configuration, the bed may be constituted by the fixed extension surface, the passenger-bearing infill surface, the second surface of the back-rest component, and the leg-rest surface. The bed in accordance with the present invention may have an overall length of at least 80" (2.032 metres) and, in some embodiments, may have a length in excess of 85" (2.16 metres).

Moreover, it has been found surprisingly that a plurality of passenger seat

assemblies according to the present invention may be arranged within a business-class section of an aircraft cabin without reducing the number of seats. Each seat defines a notional longitudinal axis that extends fore-and-aft relative to the normal manner of using a seat. It has been found that a maximal number of the seat assemblies according to the present invention may be accommodated within an aircraft cabin if each seat assembly is arranged with its notional axis to subtend an angle in the range of 35 to 55o relative to the longitudinal axis of the aircraft.

Thus, according to another aspect of the invention, there is provided an aircraft cabin installation comprising a plurality of passenger seat assemblies in accordance with the present invention, wherein said passenger seats are arranged in one or more rows that extend substantially parallely to the longitudinal axis of the aircraft cabin, with each seat being arranged such that its notional longitudinal axis subtends an angle in the range of 35 to 55o to the longitudinal axis of the cabin, wherein each seat is arranged alongside at least one neighbouring seat and is offset relative to said neighbouring seat along the notional longitudinal axis of the seat.

Preferably, a row of seats is positioned contiguously or closely adjacent to each wall of the aircraft cabin such that each seat faces into the cabin, with an extension surface behind the back-rest of the seat disposed adjacent the wall. It will be appreciated that the extension surface is only used by a passenger when the

seat is arranged in the bed configuration and accordingly the extension surface may extend into the recess defined by the concave cabin wall to maximise the use of space in the cabin. It will further be appreciated that when the seats are arranged in their seat configurations, with the back-rest components upright, the extension surfaces behind the seats are substantially concealed and form a useful storage space. Conveniently, the storage space can be used for storing bedding materials which are required only when a seat is converted into its bed configuration. For example, the storage space defined by the extension surface behind each seat can be used for storing a duvet and one or more pillows.

Advantageously, such bedding materials are concealed when the seat is in the seat configuration, giving the cabin an overall tidy appearance. When the seat is converted into the bed configuration, the back-rest is folded forwardly over the top of the seat-pan to reveal the extension surface and to allow easy access to the bedding materials stored on the extension surface which can be manually deployed on the bed surface when made.

Where cabin space permits, one ore more additional rows of seats may be provided towards the centre of the cabin. If it is possible to accommodate two central rows of seats in any given cabin, then preferably those rows are arranged back-to-back such that the extension surfaces of the seats of one row are positioned contiguously or closely adjacent to the extension surfaces of the other

central row.

In some alternative embodiments of the present invention, said back-rest component may be capable only of rotation with respect to said supporting structure, and said back-rest component and said leg-rest surface may be arranged such that, when the back rest component is moved from its upright position to its prone position, it meets said leg-rest surface to form a substantially continuous surface therewith. An extension surface may be provided behind the back-rest component of the passenger seat assembly of the present invention, which extension surface is defined by or deployable from said supporting structure, and said back-rest component may be pivoted to the structure such that when it is moved to said prone position, it also meets said extension surface such that said second surface said leg-rest surface and said extension surface form a continuous surface. Thus, in such embodiments, the back-rest component of the seat assembly is not translated forwardly as it is pivoted over the top of the seat-pan, but only rotates to meet the extension surface provided behind the back-rest and said leg-rest surface to the front of the seat. In some embodiments, said back-rest component may comprise an extension portion that, when the seat is upright, extends generally downwardly from the back-rest beyond the point at which the back-rest is pivoted to the seat pan. Thus, as the back-rest rocks forwardly to the prone position, the extension portion is raised to meet said extension surface.

Preferably, the back-rest component is connected to the supporting structure for movement between a fully upright position and a partially reclined position in which the back-rest is pivoted rearwardly relative to the fully upright position.

According to another aspect of the present invention, therefore, there is provided a seat that can be converted into a bed for a passenger vehicle, particularly an aircraft, said seat comprising:

supporting structure for supporting a seat off the floor of a vehicle;

at least one bed extension surface defined by or deployable from said supporting structure, said extension surface being substantially horizontal and elevated from the vehicle floor;

a seat-pan component;

seat-pan connecting means for connecting said seat-pan component to said supporting structure;

back-rest component having upper and lower ends and comprising first and second opposite sides, one of said sides having a first surface adapted to form the back-rest of a seat and the other side having a second surface adapted to form part of a bed;

back-rest connecting means for connecting the back-rest component to the supporting structure such that said back-rest component is pivotable forwardly from a first upright position, in which said first surface forms a seat with said

seat-pan component, to a second prone position, in which the back-rest component extends over the seat-pan component, with the second surface uppermost and substantially horizontal and meets the bed extension surface such that said second surface and said extension surface form a continuous surface serving as a bed for a passenger.

Said extension surface may be provided behind the back-rest or forwardly of the seat-pan as a foot-rest. Preferably, extension surfaces are provided both behind the back-rest component and forwardly of the seat-pan.

Said seat-pan connecting means may be adapted to allow movement of the seat-pan component in a vertical plane between a raised positioned when the back-rest component is in the upright position and a lowered position when the back-rest component is in the prone position. Said seat-pan connecting means may comprise means for biasing the seat-pan in the raised position; the arrangement being such that the back-rest component in the prone position abuts and retains the seat-pan component in the lowered position and, when the back-rest position is returned to its upright position, the seat-pan component is allowed to move to the raised position under the influence of the biasing means. Thus, as the back-rest component is pivoted forwardly from its upright position towards the prone position, it abuts on the seat-pan in its raised position, and continued movement of the back-rest component to the prone position causes the back-rest component to

push the seat-pan component downwardly towards its lowered position against the action of the biasing means. When the back-rest component is in the second prone position, the seat-pan component is retained in its lowered position by the back-rest component, but when the back-rest component is returned to its upright position to convert the seat from a bed back into a seat, the back-rest component is removed from the seat-pan, thereby allowing the seat-pan component to return to its raised position under the influence of the biasing means.

Preferably, suitable motor means are provided for automatically moving the back-rest component between the upright and prone positions and user-operable control means are provided for controlling operation of the motor means.

Preferably the back-rest connecting means are also adapted to allow the back-rest component to pivot rearwardly from an upright position to a reclined position. Said seat-pan connecting means may be adapted to allow said seat-pan component to pivot rearwardly from a generally horizontal position when the back-rest component is upright, to a tilted position when the back-rest component is reclined. Thus, in the reclined position, the back-rest component and seat-pan component may be respectively oriented to provide an ergonomically comfortable sitting position for a passenger using the seat. Both the reclining action of the back-rest component and the tilting action of the seat-pan component may be motorised under the control of said user-operable control means. Said seat-pan

connecting means may also be adapted to allow generally horizontal movement of the seat-pan component relative to the back-rest component.

Preferably, a leg-rest surface is provided, which leg-rest surface is defined by or deployable from said supporting structure and is positioned forwardly of the seat-pan component. Said back-rest connecting means may be adapted to cause the back-rest component to move translationally forwardly as it is pivoted to the second position, such that in the second position the upper end of the back-rest component meets the leg-rest surface to form a continuous surface therewith.

Said supporting structure may define a rear fixed extension surface behind the back-rest component. A movable infill component may be interposed between the back-rest component and the rear extension surface, said infill component having an upper surface adapted to form part of a bed, and infill connecting means may be provided for connecting said infill component to the supporting structure, such that the infill component is moveable between a stowed position and deployed position, wherein said infill component is disposed contiguously to said second surface of the back-rest component and said rear extension surface when deployed, the upper surface forming a continuous surface therewith. Said infill component may be pivotably connected to the lower end of the back-rest component, such that as the back-rest is moved from the first position to the second position, the infill component is caused to moved from the stowed position

to the deployed position.

The present invention thus provides an improved passenger seat assembly for use on a vehicle, particularly an aircraft, in which a back-rest component is mounted on supporting structure such that it can be reclined rearwardly from an upright position to a reclined position for passenger comfort and can be pivoted forwardly to a substantially horizontal prone position over the top of a seat-pan. The seat-pan and one surface of the back-rest component are upholstered in a manner suitable for use as a seat. The reverse surface of the back-rest component however is adapted for use as a bed surface. The seat may comprises one, and preferably two, extension surfaces behind and/or in front of the seat, and the back-rest component is pivoted to the supported structure such that when pivoted in to the prone position it meets one of the extension surfaces to form a substantially continuous surface therewith. A moveable infill component may be provided to fill-in the space between the back-rest component and the other extension surface where provided. The seat assembly of the present invention can thus be converted from a seat into a bed which is capable of accommodating even tall passengers. Advantageously, the seat assembly of the invention can be oriented at an angle of between 35 and 55o, preferably 40 to 50o relative to the longitudinal axis of an aircraft cabin such that an extension surfaces behind the back-rest component extends into the recess defined by a typical concave aircraft

cabin interior wall. Whilst the area of the cabin juxtaposed the concave cabin wall is not suitable and has insufficient headroom to accommodate a back-rest in the upright position, it can be used in accordance with the present invention to accommodate an extension surface which forms part of a bed surface. The extension surface(s), infill component and reverse surface of the back-rest component are preferably upholstered with foam padding or any equivalent material specifically for use as a bed. Thus, the bed surface of the seat assembly for the present invention may have a substantially flat surface which is oriented substantially horizontally when deployed.

Following is a description by way of example only with reference to the accompanying drawings of embodiments of the present invention.

In the drawings:

FIG. 1A is a schematic side elevation of a passenger seat assembly according to a first specific embodiment of the present invention, which seat assembly is shown in an upright position.

FIG. 1B is a schematic side elevation of the passenger seat assembly of FIG. 1A, shown in an intermediate reclined position.

FIG. 1C is a schematic side elevation of the passenger seat assembly of FIG. 1A and FIG. 1B in a fully reclined position.

FIG. 2B is a schematic side elevation of the passenger seat assembly of

FIGS 1A to 1C in another intermediate conversion position.

FIG. 2C is a schematic side elevation of the seat assembly of FIGS 1A TO 1C and FIG 2B in a bed configuration.

FIG. 3 is a schematic plan view of an aircraft cabin installation comprising a plurality of passenger assemblies in accordance with the present invention.

FIG. 4 is a schematic plan view of another aircraft cabin installation comprising a plurality of passenger seat assemblies according to the present invention.

FIG. 5A is a schematic side elevation of a passenger seat according to a second specific embodiment of the present invention, which seat assembly is shown in a seat configuration.

FIG. 5B is a schematic side elevation of the second seat assembly of FIG. 5A, shown in an intermediate position.

FIG. 5C is a schematic elevation of the second assembly of FIGS. 5A and 5B in a bed configuration.

With reference to FIGS. 1A to 1C, a passenger seat assembly for a passenger vehicle such, for example, as an aircraft, in accordance with the present invention comprises a fixed, supporting structure, generally indicated by reference numeral 10 for supporting the seat assembly of the floor F of the vehicle. Said supporting structure 10 comprises means suitable for attaching the seat assembly to

the floor. For instance, where the seat assembly is to be installed on aircraft, said supporting structure 10 typically comprises one or more fixings for attaching the seat assembly to seat tracks of the kind commonly found in the floor of the aircraft cabin. Said supporting structure 10 further comprises two elevated, passenger-supporting members 12, 14, each of which has a generally flat, substantially horizontal, upper surface. Said passenger supporting members 12, 14 are spaced apart to define a cavity 16 therebetween, within the supporting structure.

Said supporting structure 10 can be made of any suitable, aircraft grade structural materials known to those skilled in the art. Said supporting structure may be generally skeletal or may comprise one or more solid walls. Typically, said supporting structure is made from a light-weight composite material, but the aforementioned fixings for securing the supporting structure to seat tracks in an aircraft or other floor may comprise one or more reinforcing beams or plinths of light steel or aluminium; for example, extruded beams.

Said cavity 16 accommodates a passenger seat, generally indicated by reference numeral 20. Said passenger seat 20 is generally supported by the supporting structure 10 and comprises a backrest portion 22 and a seat pan portion 24. Said backrest and seat pan portions 22 and 24 are connected to the supporting structure 10 by a seat-operating mechanism, generally indicated by reference

numeral 30.

Said seat operating mechanism 30 comprises two similar, irregularly shaped, polygonal plates 32 that are mounted to either side of the seat 20. It will be appreciated that as FIGS. 1A to 1C are schematic side elevations, only one of said plates 32 may be seen. Each polygonal plate 32 is formed with a generally linear, elongate slot 34 juxtaposed one edge 35 of the plate, said linear slot 34 having upper and lower extremities 52, 53 respectively. Juxtaposed an opposing edge 36, said plate 32 carries two spaced, inwardly directed lugs 37. A notional straight line between lugs 37 subtends an acute angle with said linear slot 34. Juxtaposed a further edge 39 of said plate 32, which further edge extends generally transversely between said one and opposing edges 35, 36, said plate 32 is connected to one end of a two part linkage device 40. Said linkage device 40 comprises a first member 41 that is pivotally connected at one end to said plate 32 and a second member 42 that is pivotally connected at one end to another end of said first member 41 to form a "knee" joint 43 and is connected at another end to a fixed pivot point 44 on said supporting structure 10.

Said seat operating mechanism comprises means for linking the seat pan to the back-rest such that the lower end of the back-rest remains contiguous the rear end of the seat pan, whilst allowing said seat pan and back-rest to pivot relative to each other.

Selectively releasable mechanical locking means are also usually provided for locking the carriage means member in its upper position.

Said linear slot 34 accommodates slidingly a lug member 51 that protrudes from the respective side of the seat pan 24. Juxtaposed its forward end 25, said seat pan 24 is pivotally connected to each side, at pivot point 52; to one end of a linear strut 61. Said linear strut 61 is pivotally connected at its other end 62 to a carriage member (not shown) that is connected to and supported by the supporting structure 10 beneath the seat pan 24. Said carriage member is movably mounted to the supporting structure 10, such that the carriage member can move between an upper position corresponding to FIGS. 1A to 1C and lower position corresponding to FIGS 2B and 2C. Said suitable biassing means (also not shown), such, for example, as springs, gas struts or the like, are provided for biasing the carriage member into the upper position.

Said linear struct 61 is rockably mounted to the carriage member such that it can rock between a generally upright position as shown in FIG. 1A and a forwardly reclined position as shown in FIG. 1C.

Said spaced lugs 37 on the polygonal plate 32 engage in a curvi linear track 71 that is fixedly secured to the respective side of the backrest 22. As may be seen from FIGS. 1A to 1C and 2B to 2C, said curvi linear tracks 71 is conveniently formed in an elongate plate member 72 that is attached to the side of

the backrest. Said curvi linear track 71 has upper and lower extremities 73, 74 respectively.

With reference to FIG 1A, when said seat 20 is disposed in an upright or "dining" position, the two-part linkage device 40 is arranged in an extended configuration, such that the first and second members 41, 42 are generally co-linear with one another, and both of said first and second members 41, 42 extend generally upwardly and forwardly from said fixed pivot point 44. Said plate 32 extends rearwardly of its point of attachment to the first link member 41 and is oriented such that said linear slot 34 extends upwardly and rearwardly. The back-rest portion 22 is disposed in an upright position, and the spaced lugs 37 are disposed at the lower extremity of the curvi linear track 71. The seat pan is oriented substantially horizontally, and the lug 51 is disposed at the upper extremity 52 of the linear slot 34. The carriage member (not shown) is disposed in its upper position as described above, and the rockable, linear strut 61 is oriented generally vertically. The seat pan 24 is thus positioned rearwardly within the cavity 16, between the two passenger supporting members 12, 14.

Said seat pan 24 has an upper surface 26 that is suitably upholstered for use as a seating component. Similarly, said back rest portion 22 has a front surface 23 that is suitably upholstered as a seating component. Preferably, the front surface 23 of the backrest portion is dressed to match the upper surface 26 of

the seat pan portion 24. One of said passenger supporting members 14 is positioned forwardly of the seat 20 and serves as a fixed leg rest portion 28. Said leg rest portion 28 has an upper surface 29.

Said linear strut 61 is operably connected to a first selectively operable locking motor drive such, for example, as a linear actuator (not shown) which is capable of driving the strut 61 to rock about its other end 62, as described above, between the upright position of FIG. 1A and the forwardly inclined position of FIG. 1C. Suitable user controls (not shown) are provided in the seat assembly to enable a passenger using the seat to operate said first locking drive.

Said backrest portion 22 has a rear surface 21 that is generally planar. Said rear surface 21 is spaced from the passenger supporting member 12 by a small gap 13 when the seat is upright as shown in FIG. 1A. Said rear surface 21 carries a first mattress portion (not shown) for use as part of a bed, which mattress portion is attached to the rear surface 21 of the backrest portion 22 such that, when the back-rest is upright, the mattress portion does not become detached. Said passenger supporting member 12 also has an upper surface 11 which carries a second mattress portion. A movable infill passenger supporting member 15 is pivotally connected to a forward, transverse edge 17 of said passenger supporting member 12. Said infill member 15 is generally rectilinear and has a generally flat upper surface 18 which carries a third mattress portion (not shown). Said infill

member 15 is slidably connected to the rear surface 21 of the back-rest portion 22. As seen in FIG 1A, in the upright position, the infill member 15 extends generally uprightly between the fixed passenger supporting member 12 and the back-rest portion 22 of the seat 20 in said gap 13.

In addition to the locking drive motor for driving said linear strut 61, a second selectively operable, motorised drive is provided for rocking the second linked member 42 of said two-part linkage device 40 rearwardly about the fixed pivot point 44. Said second link member 42 comprises a rearwardly extending knuckle portion 45 (see FIG 2B) for connection to said second drive (not shown).

Said user controls may also be adapted to operate said conical locking means to release the seat pan from its upper position simultaneously with operation of said second drive.

When the seat is upright as shown in FIG. 1A, the seat may be reclined by operating the locking drive motor to rock the linear strut 61 forwardly about its other end 62, whilst the carriage member (not shown) supporting the linear strut 61 is retained in its upper position. By rocking the linear strut 61 forwardly, the seat pan portion 24 of the seat 20 is pulled forwardly within the cavity 16, and the lug 51 slides along said slot 34. Forward movement of the seat pan also causes the lower end of the back-rest 22 to move forwardly. The back-rest portion is constrained to move along a predetermined path by the engagement of the lugs 37

within the curvi linear track 71. The track 71 is shaped to cause the back-rest 22 to recline rearwardly progressively as the seat pan moves forwards.

As the seat is reclined, the lugs 37 move along said curvi linear track 71, through an intermediate position as shown in FIG. 1B, until the lugs 37 abut the upper extremity 73 of the curvi linear track 71, at which point no further movement of the seat is possible, and the seat is disposed in a fully reclined or "lounger" position as shown in FIG. 1C. It will be appreciated that the locking action of the locking drive motor allows the seat to be stopped and locked at any desired intermediate position between the two extreme positions shown in FIGS. 1A and 1C.

When a passenger using the seat assembly in accordance with the present invention wishes to go to sleep, the seat assembly can be converted into a bed. The passenger operates the user controls to release the seat pan from its upper position and to cause the second motorised actuator to rock the second link member 42 of the linkage device 40 rearwardly about said pivot point 44 as shown in FIG. 2B. As the second link member 42 is rocked rearwardly, the knee joint between the first and second link members 41, 42 is broken, allowing the first link member 41 to rock forwardly and downwardly about the knee joint 43 which, in turn, causes the polygonal plate 32 to rock forwardly and downwardly, thereby causing the back-rest portion of the seat 20 to move forwardly within the cavity 16

and to pivot forwardly from its upright position. As the back-rest portion 22 pivots forwardly, it pushes downwardly on the seat pan portion 24 which is thus caused to move downwardly on said carriage member (not shown) against the action of the biasing means. Continued rearward movement of the second linkage member 42 causes the polygonal plates 42 and back-rest portion 22 to move downwardly towards the floor F of the vehicle until, as shown in FIG. 2C, the rear surface 21 of the back-rest portion 22 is disposed substantially horizontally and co-planarly with the passenger supporting members 12, 14. The linkage member 40, polygonal plate 32, curvi linear tracks 71 and lugs 37 are arranged such that, in the bed configuration as shown in FIG. 2C, the upper end of the back-rest portion 22 abuts the rear edge of the forward passenger supporting member 14 to form a continuous surface therewith. Suitable, releasable locking means are provided for locking the back-rest 22 in the end position.

Furthermore, as seen most clearly in FIG. 2B, as the back-rest portion 22 rocks forwardly and moves translationally forwardly within the cavity 16, the infill member 15 slides along the rear surface 21 of the back-rest portion and is caused and allowed to pivot forwardly until, as shown in FIG. 2C, when the back-rest portion is disposed substantially horizontally, the infill member 15 forms a bridge between the passenger supporting member 12 and the rear surface 21 of the back-rest portion 22, such that the upper surfaces 11, 18, 21 of the passenger

supporting member 12, infill member 15 and back-rest portion 22 are substantially co-planar and form a continuous surface. It will be appreciated that the mattress portions carried by the passenger supporting member 12, infill member 15 and rear surface 21 of said back-rest 22 form an elongate mattress on which the passenger can sleep. Furthermore, the upper surface 29 of the passenger supporting member 14 forwardly of the seat 20 may also carry a mattress portion which further extends the bed formed by the seat in the bed configuration of FIG 2C. The inventors have found that the seat assembly in accordance with the present invention allows a continuous bed surface to be formed having a length of at least 80 inches (2.032 metres). In some cases, the bed formed by the upper surfaces 11, 18, 21, 29 of the passenger supporting members 12, 14, infill member 15 and rear surface 21 of the back-rest portion 22 may have a length in excess of 85 inches (2.16 metres).

In order to return the seat assembly to a seat configuration, the locking means retaining said back-rest are released, and the second motor drive is actuated to rock forwardly the second link member 42 of the two part linkage device 40 about said fixed pivot point 44, thereby causing the first link member 41 to rock rearwardly which, in turn, causes the polygonal plates 32 to rock rearwardly and move upwardly, restoring the back-rest portion 22 progressively to its upright position. As the back-rest portion 22 returns to the upright position, the seat pan

portion 24 is allowed to return to its upper position on the carriage member (not shown) under the influence of biasing (also not shown). When the seat pan is returned to its upper seat position, the mechanical locking means are automatically re-engaged to retain the seat from in said upper position.

As will be appreciate from inspection of FIGS 1A to 1C, the upper surface 11 of said passenger supporting member 12 and the upper surface 18 of said infill member 15, when the seat assembly is configured in the seat configuration, form a convenient recess 80 to the rear of the seat 20. Said recess 80 is at least partially concealed from view by the back-rest portion 22 of the seat 20. Thus, said recess 80 may be used for a storage, for example of bedding materials such as pillows, duvets, and the like. When the seat assembly is moved to the bed configuration of FIG 2C, the bedding materials can be easily accessed by a passenger and deployed upon the bed surface that is formed by the components of the seat assembly as described above.

A further advantage of the passenger seat assembly as hereinbefore described is that the front surface 23 of said back-rest portion 22 and the upper surface 26 of the seat pan portion 24 can be upholstered and covered specifically for use as seating components. Thus, for example, the back-rest portion and seat pan portion 22, 24 may carry foam padding layers that are sculptured particularly for use as seating members. The texture or patterns and/or colourways of the

upholstery and dressing materials used for covering the front surface 23 of the back-rest portion and upper surface 26 of the seat pan portion may be selected specifically for use as seating materials. Conversely, the mattress portions carried by the passenger supporting member 12, infill member 15 and rear surface 21 of back-rest portion 22 may be specifically adapted for use as bedding materials. Thus, interior sprung mattress portions or foam padding layers may be used which are specifically shaped for maximum passenger comfort when the seat is used as a bed. In particular, the materials and fabrics used to dress the mattress portions may have textures, colours, etc that are particularly suitable for use as bedding materials. The bedding materials used to dress the mattress portions and the materials used to dress the seating portions of the seat assembly may have quite different appearances from one another. However, as will be appreciated, when the seat is configured for use as a seat, the bedding materials are largely concealed by the back rest portion 22, leaving visible only those parts of the seat that are used actually form part of the seat. Similarly, when the seat is reconfigured for use as a bed, the front surface of the back-rest portion and upper surface of the seat pan portion are substantially concealed from view, leaving visible only the bedding materials comprising the mattress portions on the passenger supporting component 12, infill member 15 and rear surface 21 of the back-rest portion 22.

Where a plurality of passenger seat assemblies in accordance with the

present invention are installed in a vehicle cabin, for example, on an aircraft, they can be used to give the aircraft cabin two different visual appearances or ambiences according to whether a majority of the seat assemblies are disposed in the bed configuration or seat configuration. Thus, during a daytime flight, or during a daytime portion of a long haul flight, all or a majority of passenger seat assemblies will be arranged in a seat configuration as per one of FIGS 1A to 1C. The bedding materials will be substantially concealed, leaving visible only the seating surfaces of the assemblies. The seat assemblies may, of course, be dressed to any desired design, but, for example, the seat assemblies may be upholstered and dressed to give the cabin the appearance of a private members' club environment. For instance, the upper surface 26 of the seat pan portion 24 and front surface 23 of the back-rest portion 22 may be upholstered in leather. During a night-time flight, or during the night-time portion of a long haul flight, a majority, or all, of the seat assemblies will be configured in the bed configuration as per FIG. 2C, in which case the seating portions of the assemblies will be substantially concealed, leaving visible only the bedding materials carried by the upper surfaces 11, 18, 71, 29 of the passenger supporting members 12, 14, infill member 15 and back-rest portion 22. The materials used to dress the mattress portions may have a significantly "softer" appearance than the materials used to dress the reverse seating side of the back-rest portion 22, in order to give the

passenger cabin an attractive, restful ambience that is appropriate for sleeping.

FIGS. 3 and 4 show respectively two different cabin installations, each comprising a plurality of seat assemblies according to the present invention. In FIG. 5, an aircraft cabin is defined *inter alia* by two opposing curvi linear walls 101, 102. As is well known to those skilled in the art, each of said walls, 101, 102 is generally concave on its internal surface. Juxtaposed each of said walls 101, 102 is provided a column of passenger seat assemblies 110 in accordance with the present invention. Each seat assembly 110 defines a notional, longitudinal axis indicated by reference numeral 112 in respect of a representative one of the seat assemblies 110. The seat assemblies 110 are oriented at an acute angle with respect to the adjacent cabin wall 101, 102. FIG. 3 also shows, in juxtaposition with wall 101, a notional "forwards" axis 114. It will be appreciated that, towards the front of the aircraft, the "forwards" axis 114 may not, in fact, be oriented precisely forwardly with respect to the direction of travel of the aircraft, but is oriented substantially parallelly to the fore-aft direction of the adjacent side wall 101, ignoring the slight curvature of that side wall 101. Each of said passenger seat assemblies 110 is oriented to define an angle α of about 40° between the notional, longitudinal axis 112 of the seat assembly and a notional "forwards" axis 114 of the aircraft cabin. Each seat assembly is positioned such that the passenger supporting member 12 is disposed adjacent the juxtaposed cabin

wall 101, 102, such that the passenger supporting member 12 extends into the recess defined by the concave nature of said side wall 101, 102. The seat 20 is positioned facing forwardly and inwardly with respect to the cabin, and a low privacy screen 27 is formed around the forward end of the passenger supporting member 14, so as to define a personal passenger space around each seat assembly. By positioning each seat assembly such that the passenger supporting member 12 extends into the recess defined by the concave side wall 101, 102, maximum use is made of the space available in the aircraft cabin. As will be appreciated, the passenger supporting member 12 is only used by a passenger when the seat is arranged in a bed configuration, and thus, full-height head room is not required above the passenger supporting member 12.

Suitable privacy screens may be provided between adjacent seats, and as shown in FIG. 3, a space 115 adjacent each seat assembly and behind the passenger supporting member 12 of a neighbouring seat assembly may be used to provide a generally seat-height surface for use as a cocktail table or the like.

Where cabin space permits, one or more central columns of seat assemblies 120 may be installed in addition to columns of seat assemblies 110 juxtaposed the cabin walls 101, 102. FIG. 3 shows a cabin installation in which two central columns of seat assemblies 120 are installed. Within each column, the seat assemblies are arranged, as described above, at an acute angle to the fore-aft axis

of the aircraft cabin. The seat assemblies 120 are also arranged in rows of two and, within each row, the seat assemblies are generally arranged back-to-back, so that the passenger supporting members 12 of adjacent seats within the same row are disposed contiguously to one another and, when the seats are in the seat configuration, are substantially concealed from view by the juxtaposed back-rest portions of the seat 20.

FIG. 4 shows a cabin installation suitable for a different aircraft comprising three columns of seat assemblies 220, comprising two columns that are disposed respectively juxtaposed the two longitudinal walls 201, 202 of the cabin and a single, central column. As with the installation shown in FIG. 34, the seat assemblies in each column juxtaposed one of the cabin walls 201, 202 are oriented such that the seats face forwards and inwards with respect to the cabin. The seat assemblies within the central column are also arranged to face forwards and to one side. All seat assemblies define an acute angle β of about 49° between the notional longitudinal axis 212 of the seat assembly and a fore-aft axis 214 of the cabin.

FIG. 5A shows a passenger seat assembly according to a second embodiment of the present invention. For components of the seat assembly of FIG 5A that are similar to corresponding components of the assembly of FIGS. 1A to 1C and FIGS. 2B to 2C, the same reference numerals will be used, with the

addition of a preceding numeral 3. Thus, the supporting structure 310 of the second embodiment of FIG. 5A corresponds to supporting structure 10 of the seat assembly of FIG 1A.

The seat assembly according to the second embodiment comprises a supporting structure generally indicated by reference numeral 310, for supporting the assembly off the floor F of a vehicle such, for example, as the floor of an aircraft cabin. Similar to the seat assembly of the first embodiment described above, the seat assembly of the second embodiment comprises two elevated passenger supporting members 312, 314 that are spaced apart and oppose one another to form a cavity 316 within the supporting structure. Said cavity 316 accommodates a seat, generally indicated by reference numeral 320, which seat comprises a back-rest portion 322 and a seat pan portion 324. Said seat pan portion 324 has a forward end 325 and a rear end 323 and is pivoted at its rear end 323 to a lower end 326 of the back-rest portion 322. Said seat pan portion 324 is movably connected to and supported by the supporting structure 310 by a mechanism (not shown) which allows the seat pan portion 324 to move substantially vertically within the cavity 316 between an upper position as shown in FIG. 5A and a lower position as shown in FIG. 5C. Suitable biasing means are provided (not shown) for biasing seat pan portion 324 into the upright position and selectively locking means are provided for locking the seat pan in the upper

position.

Said back-rest portion 322 is pivoted to said supporting structure 310 at a fixed pivot point 330. Said back-rest portion 322 has a rear surface 321 which comprises an extension portion 331 at the lower end 326 of the back-rest portion 322, which extension portion 331 extends downwardly beyond the fixed pivot point 330 when the back-rest portion 322 is in an upright position.

The upper surface of the seat pan portion 324 and front surface of the back-rest portion 322 are upholstered and covered with materials that are specifically designed for use as seating materials. The passenger supporting member 314 is spaced forwardly of the seat 320 and can be used as a leg-rest portion 328 when the seat 320 is in an upright position as shown in FIG. 5A. The passenger supporting member 312 is disposed behind the back-rest portion 322 and separated therefrom by a small gap 313.

Said rear surface 321 of the back-rest portion 322 is generally flat and carries a first mattress portion (not shown) which is designed and dressed specifically for use as a bedding component. Said passenger supporting member 312 has an upper surface 311 which carries a second mattress portion. The back-rest 322 and passenger supporting member 312 define a recess 380 behind the back-rest 322 which can be used for storage of bedding materials such as pillows, duvets, rugs, blankets and the like. It will be appreciated that an

advantage of the passenger seat assembly according to the second embodiment is that when the back-rest is in the upright position as shown in FIG. 5A, the recess 380 is concealed from view, thus tidily hiding any bedding materials stored in the recess.

Said back-rest portion 322 is pivotable from an upright position in FIG. 5A about said fixed pivot point 330 to a bed position as shown in FIG. 5C. Said back-rest portion 322 and said pivot point 330 are designed, with the passenger supporting member 312, 314 such that in the bed position, the rear surface 321 of the back-rest portion 322 is disposed contiguously to both of said passenger supporting members 312, 314 to form a generally flat, substantially continuous surface therewith. In the bed configuration of FIG. 5C, the second mattress portion carried by the upper surface 311 of the passenger supporting member 312, and the first mattress portion carried by the rear surface 321 of the back-rest portion 322 abut or nearly abut one another to form an elongated bed on which a passenger using the seat may sleep. The upper surface 329 of the passenger supporting member 314 also forms an extension surface to be bed. As with the seat assembly of the first embodiment described above, the inventors have found that in accordance with the seating assembly of the second embodiment, it is possible to form a bed having a total "point-to-point" length of at least 80 inches (2.032 cm) and, in some cases, at least 85 inches (2.16 cm).

Movement of the back-rest portion 322 between the upright and bed positions of FIGS. 5A and 5C may be motorised (not shown) and suitable user-operable controls (also not shown) may be provided adjacent seat 320 to enable a passenger to control operation of the seat. When the seat is in the upright position as shown in FIG 5A, the locking mechanism may be removed thereby releasing the seat pan front is upper position and operation of the motor drive causes the back-rest portion 322 to rock forwardly about said fixed pivot point 330. As the back-rest portion 322 rocks forwardly, it abuts on the seat pan portion 324, pushing the seat pan portion 324 downwardly in the cavity 316, against the action of the aforementioned biasing means.

In the bed position as shown in FIG. 5C, the seat pan portion 324 is completely concealed by said back-rest portion 322. Thus, as with the first embodiment described above, the front surface of the back-rest portion 322 and upper surface of the seat pan portion 324 may be covered with materials to give a completely visual appearance and cabin ambience from those materials used to dress the bedding parts carried by the rear surface 321 of the back-rest portion 322 and upper surface 311 of the passenger supporting member 312. When the back-rest portion 322 is upright, the seating surfaces of the back-rest portion 322 and seat pan portion 324 are visible, whilst the bedding surfaces of the rear surfaces of the rear surface 321 of the back-rest portion 322 and upper surface 311

of the passenger supporting member 312 are concealed. On the other hand, when the seat is in the bed configuration of FIG. 5C, the seat surfaces of the back-rest portion 322 and seat pan portion 324 are concealed, whilst the bedding surfaces 321 and 311 are visible.

In accordance with a particular aspect of the seating assembly of the first and second embodiments described above, therefore, the back-rest component 22; 322 has a first seating surface 23; 323 which forms part of a seat with the upper surface 26; 326 of the seat pan 24; 324 and an opposite bed surface 21; 321 which is adapted to form part of a bed with one or more other passenger supporting members 12, 14; 312, 314.

The passenger seat assembly in accordance with the present invention is thus particularly advantageous because it allows a long bed to be provided for a passenger in an aircraft cabin or other vehicle which capable of accommodating comfortably even very tall passengers having a height greater than 80 inches (2.032 cm) at a minimal seat pitch. By positioning a seat assembly, in accordance with the present invention, juxtaposed a concave cabin wall, with the passenger supporting member 12; 312 disposed adjacent said cabin wall, it is possible to use efficiently the available space within the cabin. In a seat configuration, the back-rest portion 22; 322 forms a recess 80; 380 with the passenger supporting member 12; 312 which can used to conceal tidily bedding materials such as rugs,

blankets, pillows, etc. The seat and bedding surfaces of the back-rest portion 22; 322 can be given respectively different visual appearances such that in a cabin installation comprising a plurality of seat assemblies according to the present invention, a first cabin ambience can be obtained when all or a majority of the seat assemblies are disposed in the seat configuration, a second, different, ambience can be obtained when all or a majority of the seats are disposed in the bed configuration. Furthermore, the seat and bedding surfaces can be respectively adapted specifically for use for their given purposes. Thus, for example, the seating surface of the back-rest portion 322 may be provided with foam padding or the like which is sculptured particularly for use as a seating component, whilst the bedding surface of the back-rest portion can be equipped with a mattress portion or other comfortable, resilient layer that is shaped specifically for use as a bed component. Another advantage of the seat assembly in accordance with the present invention is that, in the bed configuration, the seat pan portion 24; 324 is completely or substantially concealed by the back-rest portion 22; 322, such that the appearance of the materials used to cover the seat pan portion 24; 324 do not spoil the appearance and ambience afforded by the bedding materials. Preferably, the seat assembly in accordance with the present invention comprises a leg-rest portion 28; 328 spaced forwardly of the seat 20; 320 and, in the bed configuration, the leg-rest portion also forms part of the extended bed surface.

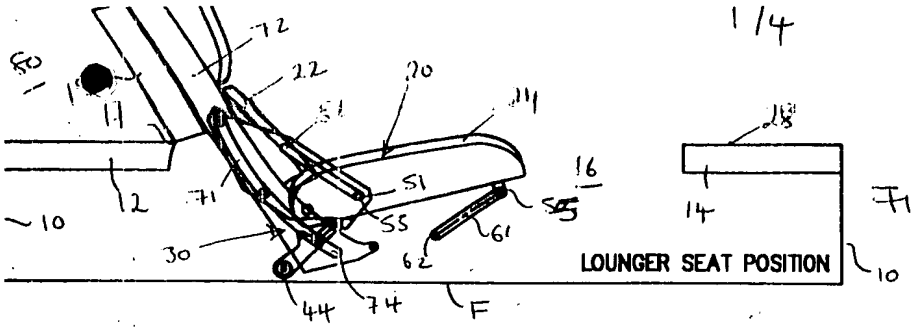


FIG. 1C

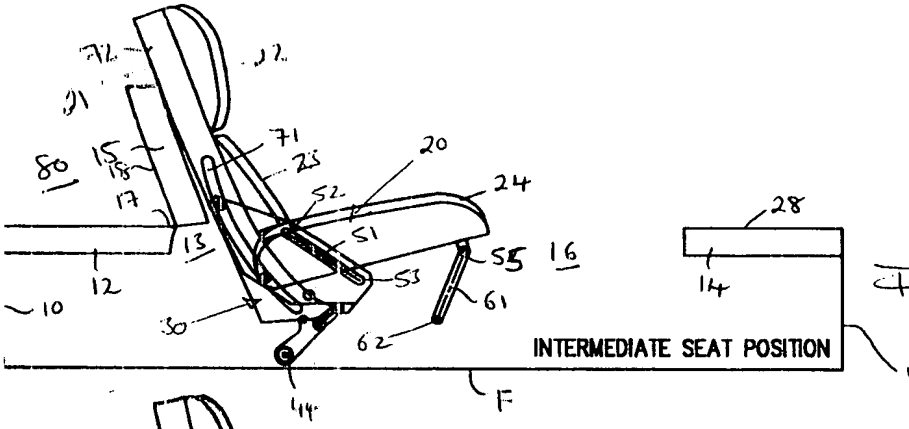


Fig. 1B

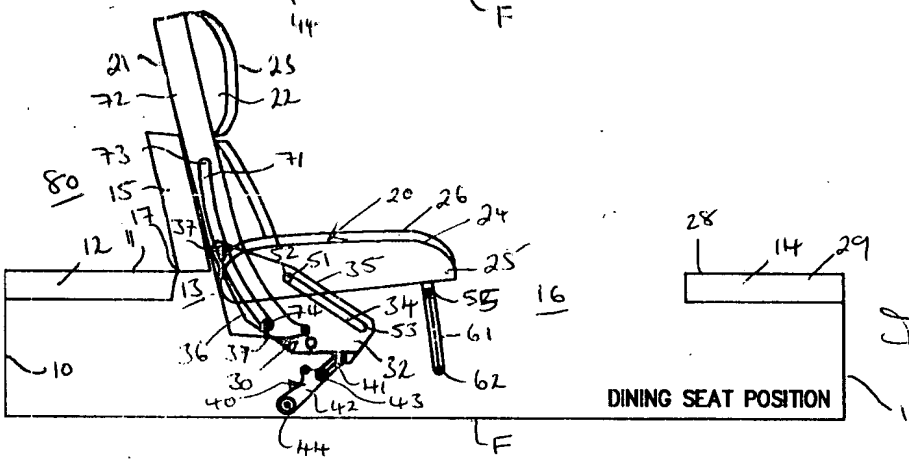


Fig. 1A

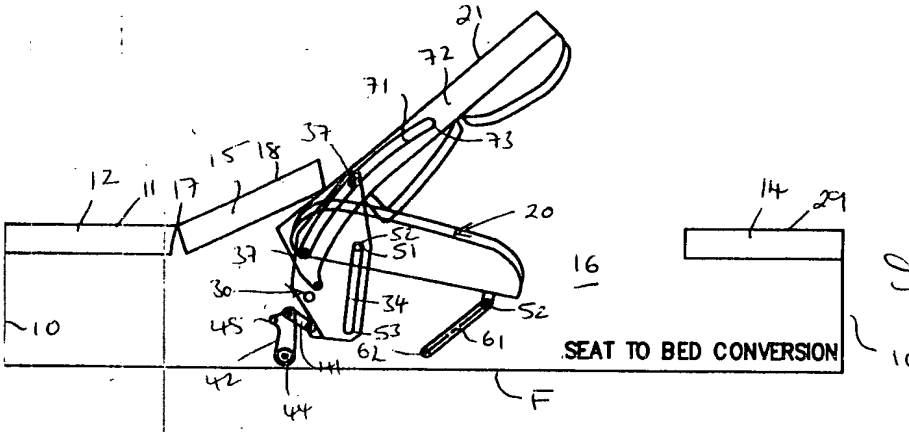


Fig. 2B

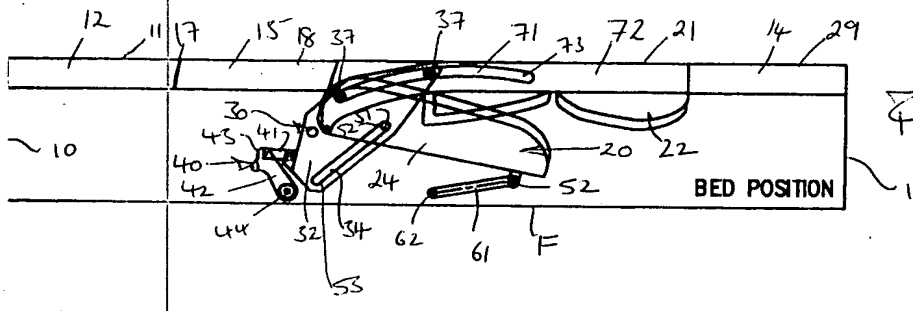
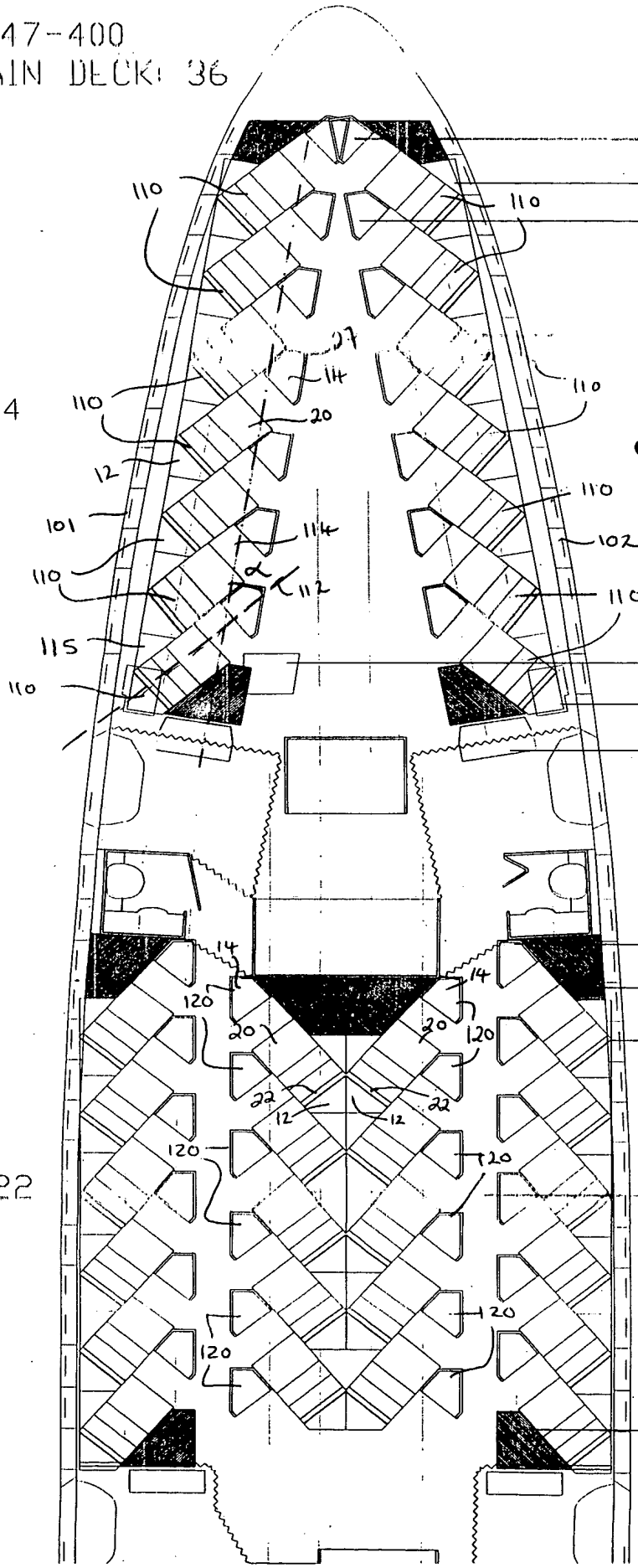


Fig. 2C

BOEING 747-400
TOTAL MAIN DECK: 36
CONFIG A

A ZONE: 14

B ZONE: 22



BESPOKE FOOTSTOOLS

INTERFERENCE ON SIDEWALL

BESPOKE FOOTSTOOLS
(NEED 3in OFF FOR AISLE)

40 DEGREES + A ZONE ANGLE

VAA STRICTLY CONFIDENTIAL

HATCH - OK IN THIS CONFIG

02 BOTTLES + CAGE INTERFERENCE
AIRFLOW - RN - CREW TRAINING

CREW SEATS COST 6.5in OF A ZONE
REPLACING = ~$16K EACH

BESPOKE FOOTSTOOL
(NEED ON ALL FRONT ROWS)

STOWAGE AREAS HIGHLIGHTED RED
MOST NEED ACCESS OVER PAX

INTERFERENCE ON SIDEWALL

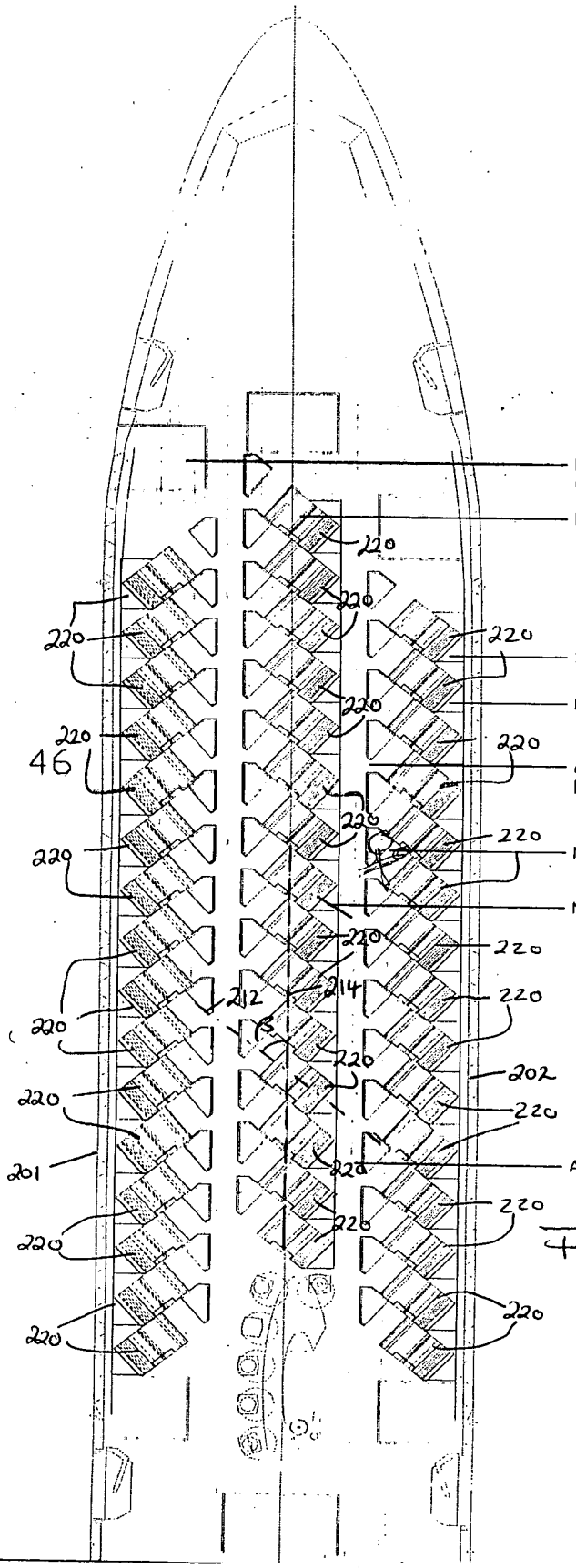
AISLE WIDTH 15.5in

Fig. #3

STRUCTURAL FOOTSTOOL
WITHIN WARDROBE
(NEED ON ALL REAR ROWS)

AIRBUS A340-600
TOTAL: 46

FORWARD CABIN: 46



MOVEMENT OF LOO INTO IFBT (INCLUDES MOVEMENT OF A CREW SEAT)

LOO VISABILITY

SMALLER TABLE THAN 747

HIC ISSUES

ACCESS CHANNEL TIGHT NEED TO RESHAPE FOOTSTOOL

NO ROOM FOR SOFA POSITION

NEED PROTECTION FOR HEAD BY AISLE

AISLE WIDTH 15.5in

Fig. 54

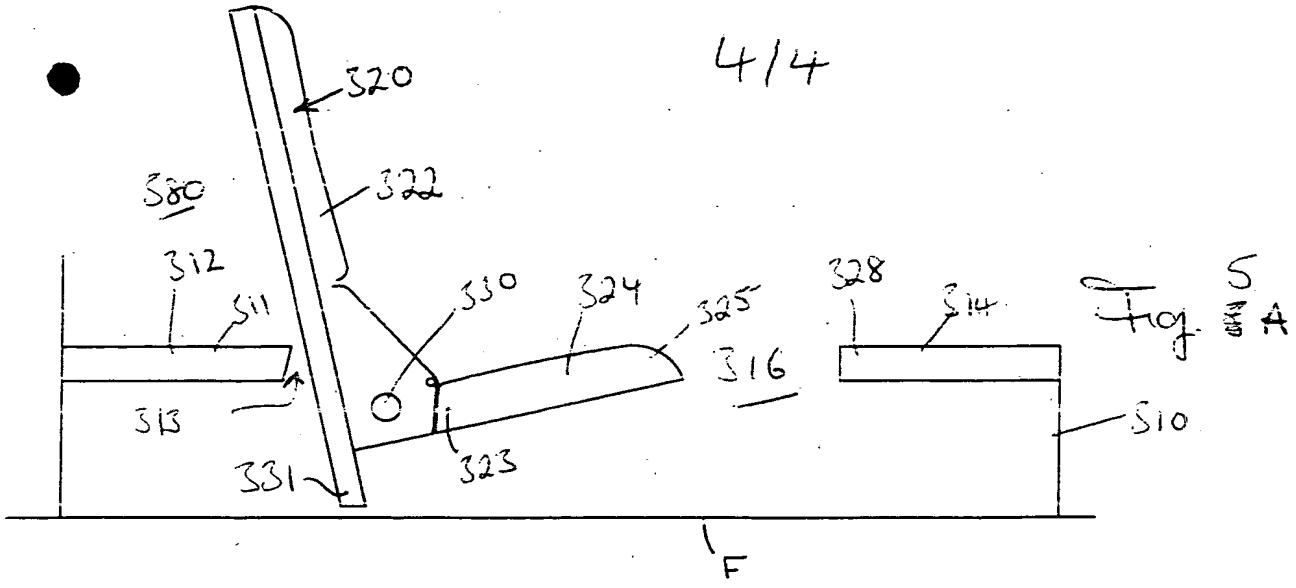


Fig. 5A

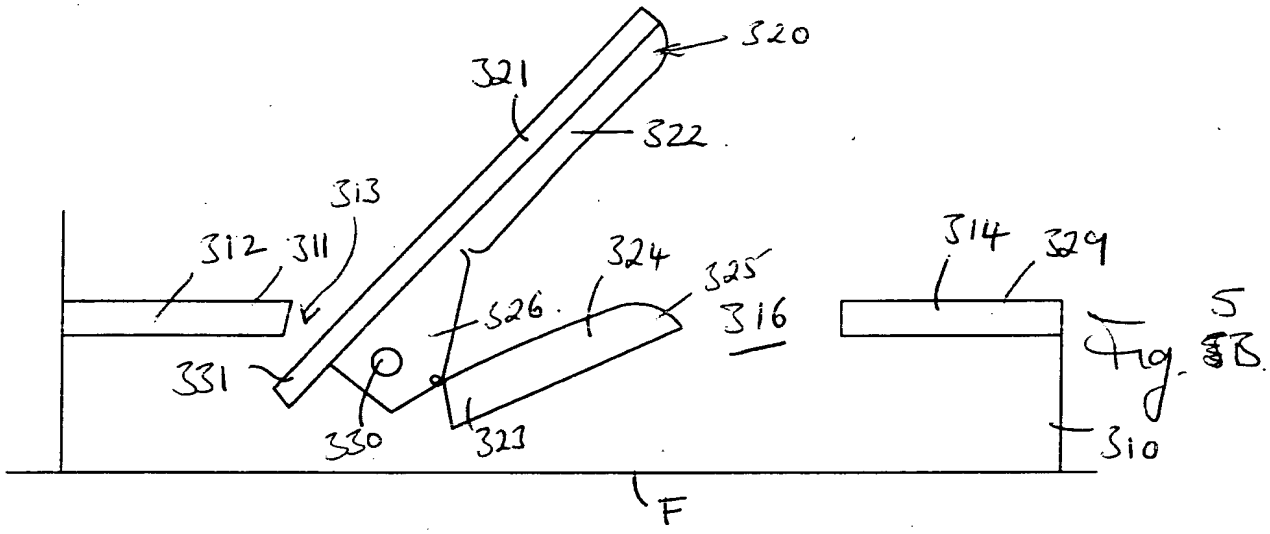


Fig. 5B

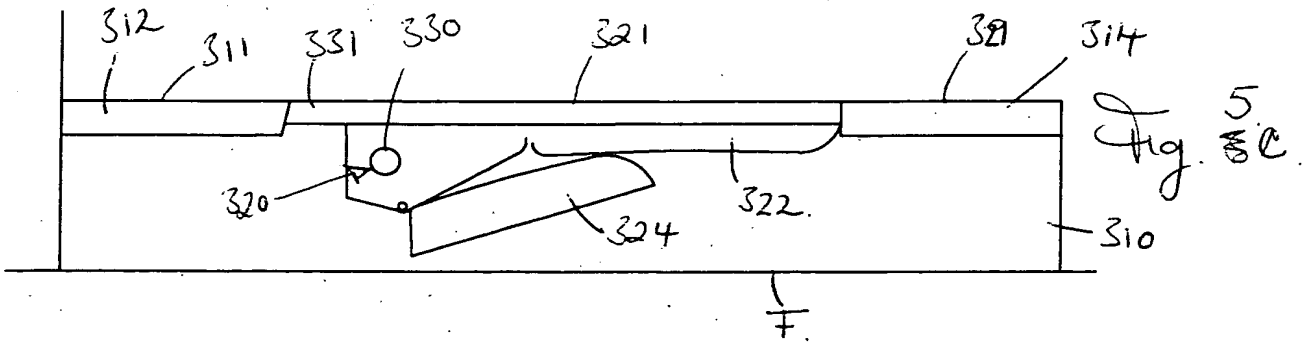


Fig. 5C